State of California **The Resources Agency**

M e m o r a n d u m

Date: September 25, 2007

To: Victor Pacheco, Delta Conveyance Branch Chief
Ajay Goyal, Supervising Engineer

From: Jim Wilde, Senior Engineer
Department of Water Resources

Subject: Modeling of Value Engineering Study Alternatives for the Through Delta Facility

Introduction

The CALFED program included in their Record of Decision actions to include "studying and evaluating a screened diversion facility on the Sacramento River with a range of diversion capacities up to 4,000 cfs" conveying Sacramento River water between Hood and Georgiana Slough to the central Delta (CALFED). This memorandum provides model study results of four alternatives to increase the transfer flow of high quality Sacramento River water to the central Delta, as shown in Figure 1, and thereby reduce salinity at the State Water Project (SWP) and the Central Valley Project (CVP) export pumps. Strategic Value Solutions, Inc. (SVS, Inc), under contract with DWR, assembled an independent multidisciplinary team to review the Through Delta Facility (TDF) design criteria, conceptualize alternative designs, and estimate the feasibility of each alternative. DWR prepared objectives and basic design criteria based on the CALFED Record of Decision for consideration by the Value Engineering (VE) team. DWR provided direction along with these objectives and design criteria to the VE team at a workshop in late March 2007. In July 2007, SVS Inc. provided the finalized VE report for the TDF project. The report analyzed and described several design alternatives to a TDF project to increase the transfer flow, maintain the health of the Delta ecosystem, and assess preliminary feasibilities. The VE team recommended further exploration, including modeling, of the higher ranked TDF alternatives.

Methodology

DWR contracted RMA, Inc. to model the higher ranked VE alternatives with the Delta Simulation Model (DSM2). DSM2 is a one dimensional hydrodynamic-water quality model calibrated to the Sacramento-San Joaquin Delta (Nader-Tehrani). The base run is the historical simulation as constructed by DWR's Delta Modeling Section. The time period of the base simulation is June 1990 through March 2007. All boundary conditions and Delta operations in the base simulation approximate historical data. These would include the Sacramento River Delta inflow at Freeport, the San Joaquin River Delta inflow at Vernalis, the boundary stage at Martinez, export pumping, Clifton Court Forebay gate operations, south Delta barrier operations, and the Delta Cross Channel (DCC) operations.

The TDF alternatives were modeled individually using the input files of the base simulation without any changes to the base boundary conditions or operations. All simulations utilize the DSM2 “object-to-object” transfer function which directly transfers water and its associated quality from one node to another. This method, versus building conveyance canals in the model, was deemed appropriate for this comparative analysis. Generally 4000 cfs was transferred, “pumped”, out of the Sacramento River to the Mokelumne River region as compliance with SWRCB requirements were maintained. Pumping was lowered, as needed, to meet requirements, such as Rio Vista minimum flows. The TDF simulation alignments are independent and modeled as follows (also see Figure 1):

1. The first alternative modeled a transfer from the Sacramento River at Hood to the South Fork of the Mokelumne River.

2. The second alternative modeled a transfer from the Sacramento River at Hood to Snodgrass Slough at Lost Slough.

3. The third alternative modeled a transfer from the Sacramento River just upstream of the Delta Cross Channel to the South Fork of the Mokelumne River.

4. The fourth alternative modeled a transfer from the Sacramento River just downstream of Georgiana Slough and across the path of Georgiana Slough and the North Fork of the Mokelumne River, via siphons, to the South Fork of the Mokelumne River.

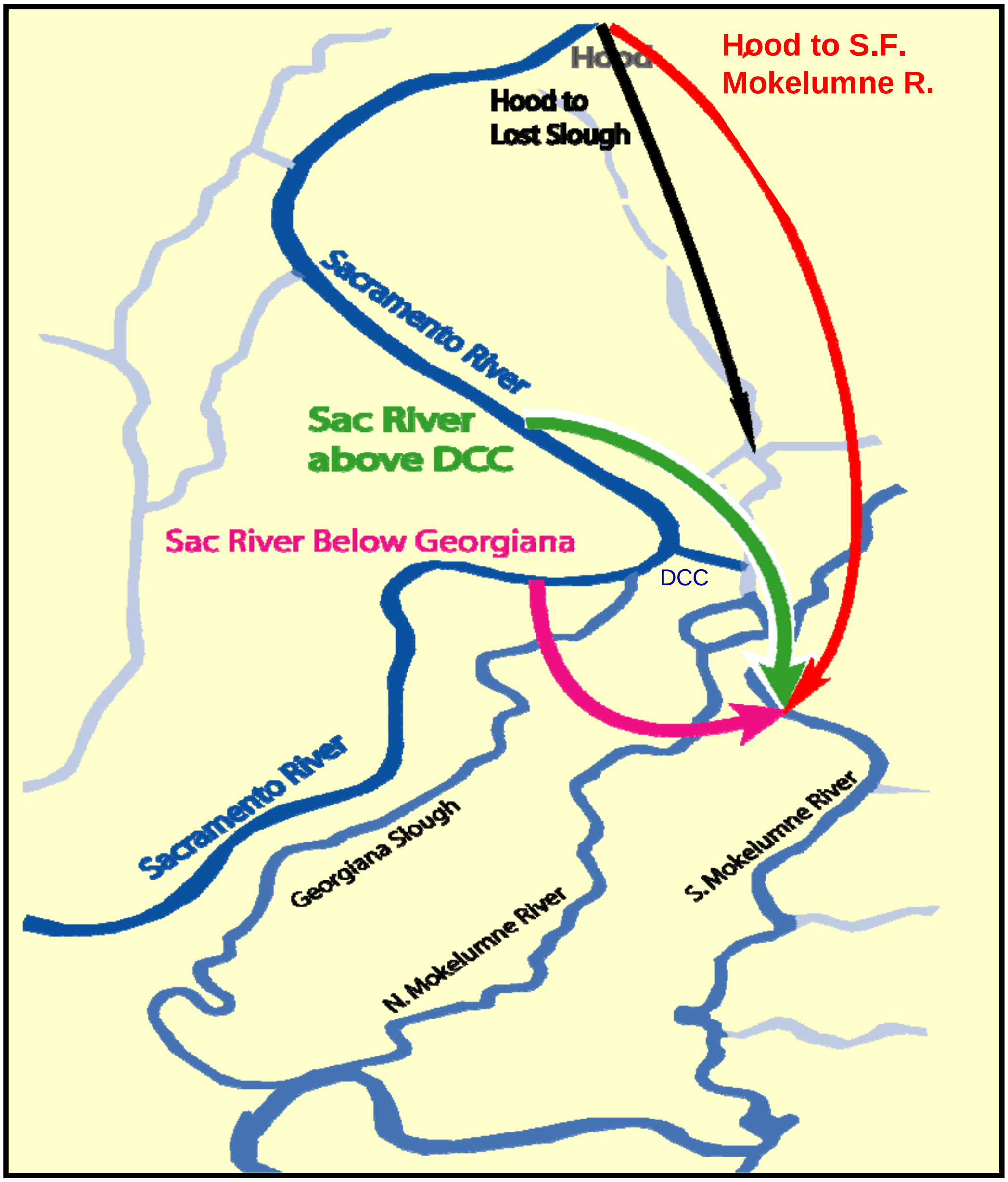

Figure 1 – Map of the TDF Alternative alignments (Modeled independently)

Model results

Flows

The north Delta transfer flow is the sum of flow through Georgiana Slough, DCC, and TDF to the central Delta. Modeled flows in the Mokelumne River and Delta Cross Channel region show the pumping in the TDF alternatives increases the north Delta transfer flow. However, the increased transfer flow does not match the quantity pumped through a TDF canal when the DCC is open. For example, the TDF alternatives are pumping 4000 cfs from June 2002 through November 2002; however, the increased transfer flow is roughly 2000 cfs as a result of a 2000 cfs decrease in flow through the DCC, as shown in Figure 2. The gravity flow through the DCC is hindered by the extra volume of water in the Mokelumne River region due to the TDF alternatives, the incoming energy of flood tides moving up the Mokelumne River, and channel constrictions near the confluence of Snodgrass Slough and the North Fork of the Mokelumne River. The restricted flows through these local channel constrictions were revealed when modeling an extended DCC gate structure (Wilde). When the DCC is closed, January 2002 through May 2002, the increased pumping is fully reflected in the increased north Delta transfer flow, as shown in Figure 2.

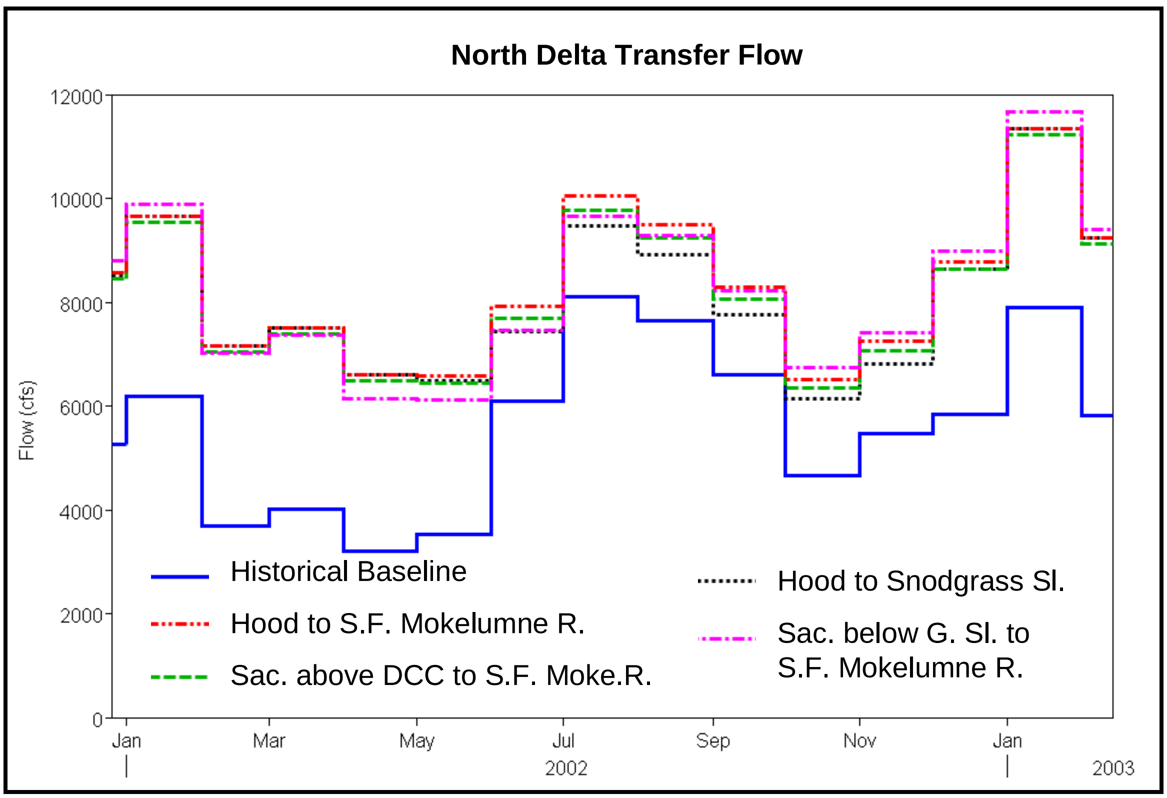

Figure 2 - Monthly average flow through Georgiana Slough + DCC + TDF

Salinity

The analyses of the DSM2 simulations indicate there would be some decreased salinity at Clifton Court Forebay for the TDF alternatives (Figure 3). The Hood to S.F. Mokelumne R. alignment provides the greatest reduction in salinity in the forebay. Almost as beneficial is the TDF alignment downstream of Georgiana Slough to the South Fork of the Mokelumne River. Times of noticeable salinity reduction are in the late summer and fall periods when the net Delta outflow is low. There are times when salinity reductions are marginal if not zero. These minimal salinity reduction periods indicate times when the inflow from the San Joaquin River dominates the source-water components flowing into the forebay; typically this is in the spring and early summer of normal and above normal rainfall years.

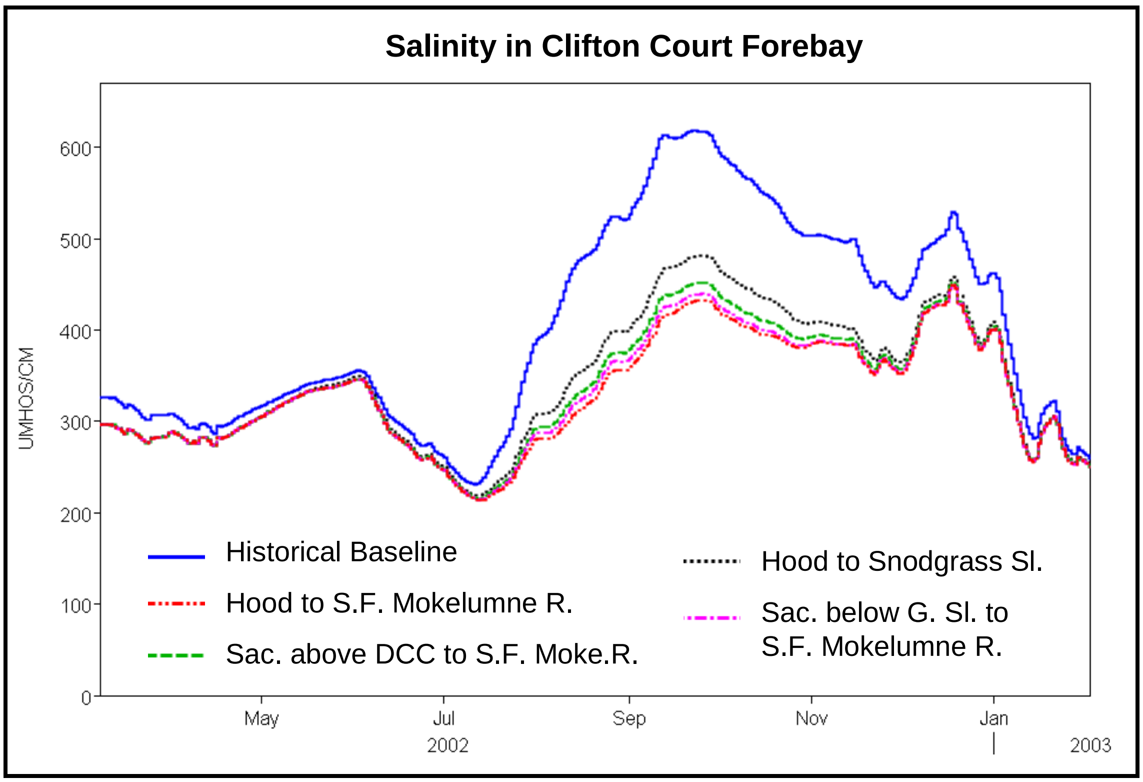

Figure 3 – DSM2 modeled salinity for 2002 at Clifton Court Forebay with the TDF alternatives (the Base is the historical simulation)

The decreased monthly average salinity reductions of all of the TDF alternatives are within 5% of each other. The greatest potential export water quality improvement is a decreased monthly average salinity of 89 uS/cm or 17% in Clifton Court Forebay (Table 1 and Figure 4) in the fall season for the Hood to S.F. Mokelumne R. alignment and the alignment crossing Georgiana Slough. The lowest performing TDF alternative, Hood to Snodgrass Slough at Lost Slough, drains into the same region where the flood tide carried through the DCC sequesters until the ebb tide allows release to the central Delta through the Mokelumne River. This hydrodynamic behavior and the shallow channels at the mouth of Snodgrass Slough contribute to this alternative's modest salinity reduction at the exports.

Table 1

Salinity Improvement Over the Base Historical Simulation at Clifton Court Forebay (1990-2007) *

	Upstream of DCC to SF Mokelumne R. (uS/cm)		Hood to Lost Sl. (uS/cm)		Downstream of G. SL. to SF Mokelumne R. (uS/cm)		Hood to S.F. Mokelumne R. (uS/cm)	
Average Month	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
January	49	198	45	198	51	201	52	204
February	26	103	22	103	26	104	27	105
March	21	140	18	140	21	148	21	147
April	13	66	12	66	13	67	14	68
May	9	33	7	33	9	34	9	34
June	25	123	20	123	26	131	27	135
July	33	143	27	143	35	151	36	149
August	55	171	45	171	59	183	61	188
September	71	190	58	190	76	208	78	204
October	82	166	67	166	88	180	89	179
November	83	163	69	163	89	180	89	173
December	86	160	75	160	90	163	90	166
Overall Average	47	198	39	198	49	208	50	204

* Minimum values are at or near zero

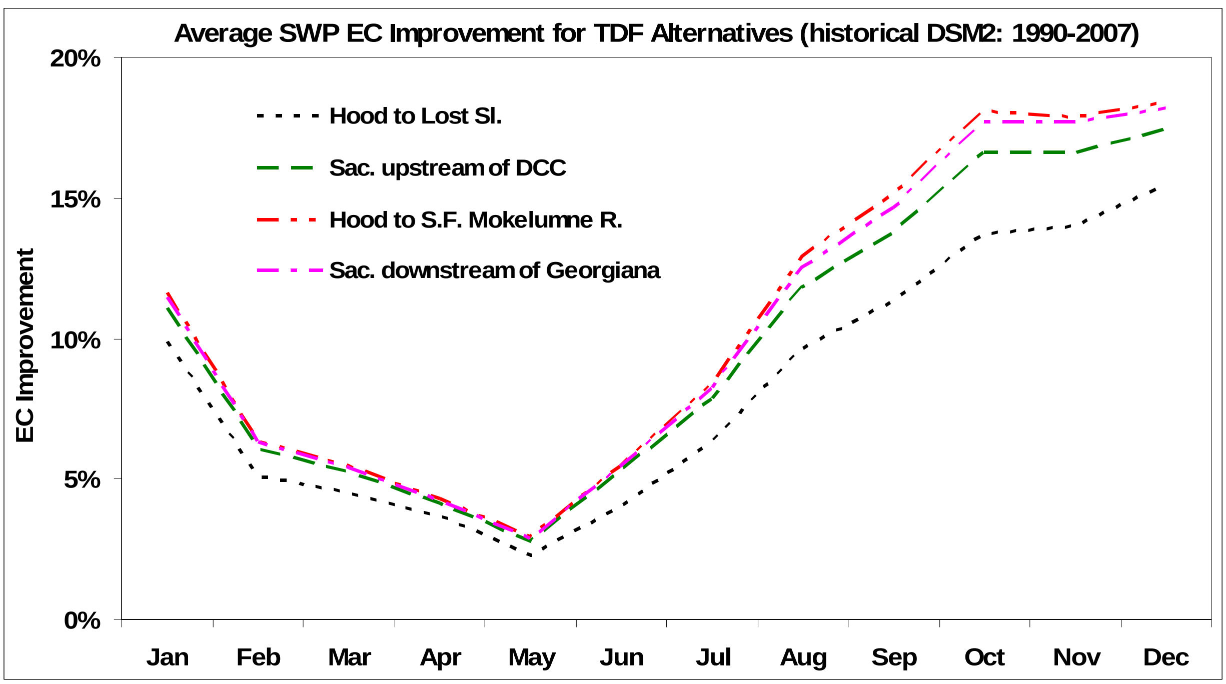

Figure 4 – Average long term TDF alternative salinity improvements at Clifton Court Forebay compared to the historical simulation as modeled with DSM2.

DOC

Dissolved Organic Carbon (DOC) was also modeled with DSM2. In these simulations the TDF pumps were operated at 4000 cfs continuously to best understand their influence on DOC concentrations at the major Delta exports. The model estimates minimal improvements to DOC levels in Clifton Court with all TDF alternatives. Figure 5 shows the historical DOC at Clifton Court Forebay with the most beneficial alternative, the Hood to S.F. Mokelumne R. alignment. DOC levels are of main concern in the winter period where the higher runoffs during rain events, especially after a dry period, carry higher concentrations. Unfortunately during these periods, with the high DOC contributions from Delta agriculture lands as well as the higher DOC levels in the Sacramento River, the TDF facilities do not appreciably decrease DOC levels at the exports.

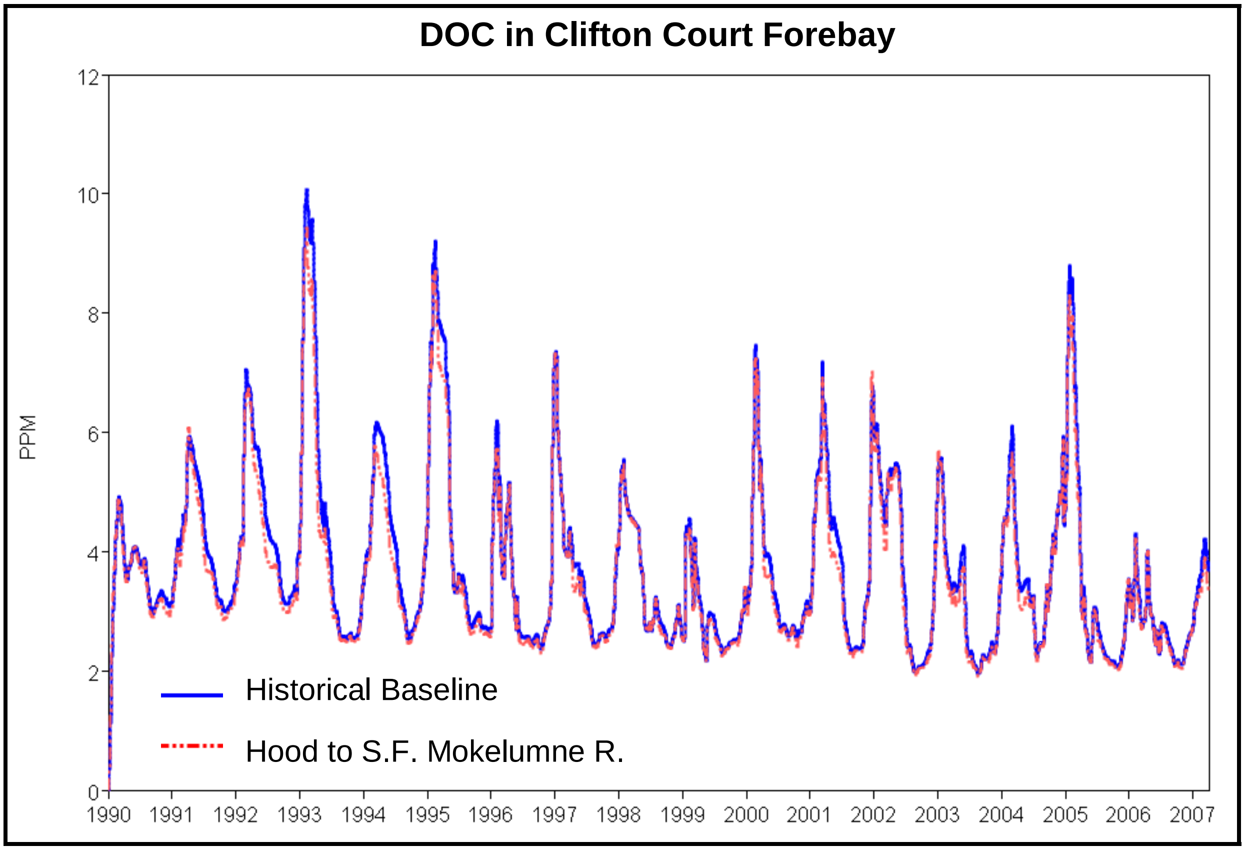

Figure 5 – Estimated DOC at Clifton Court Forebay

Conclusion

DOC levels were not greatly reduced with the TDF project. Modeling the historical Delta simulation and the preferred VE report TDF alternatives indicate a noticeable improvement to salinity levels, however, at Clifton Court Forebay in the late summer and fall seasons. The Hood to S.F. Mokelumne R. alignment and the alternative alignment across Georgiana Slough produced similar results and the largest reduction in salinity. The alignment from Hood to Snodgrass Slough at Lost Slough produced the least improvement. This alternative may improve with dredging in the lower portion of Snodgrass Slough, as suggested in the analysis of the DCC reoperation modeling documented in DWR memo dated September 24, 2007. Given the current modeling results and the estimated alternative costs in the VE Report the alternative across Georgiana Slough at this time proves to be the most feasible alternative.

References

CALFED Programmatic Record of Decision (2000), CALFED Bay-Delta Program
http://calwater.ca.gov/calfed/library/library_archive_rod.html

Nader-Tehrani, P. (2001). "Chapter 2: DSM2 Calibration and Validation." *Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh. 22nd Annual Progress Report to the State Water Resources Control Board*. Sacramento, CA: California Department of Water Resources, Office of State Water Project Planning.
http://modeling.water.ca.gov/delta/reports/annrpt/2001/2001Contents.pdf

SVS, Inc (2007) – Strategic Value Solutions. "Value Planning Study – Through Delta Facility." Independence, MO. Prepared for DWR – Delta Conveyance Branch, Sacramento

Wilde, J. to Pacheco, V. and Goyal, A. interoffice memorandum regarding "Modeling of a Delta Cross Channel Gate Extension" September 24, 2007. Delta Conveyance Branch, Bay-Delta Office, DWR.